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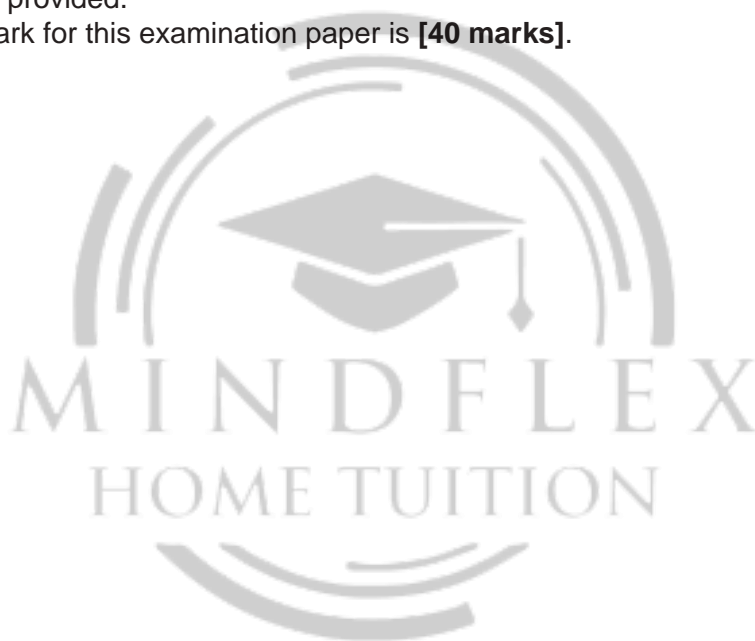
Biology
Higher level
Paper 1

Thursday 5 November 2015 (morning)

1 hour

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- The maximum mark for this examination paper is **[40 marks]**.



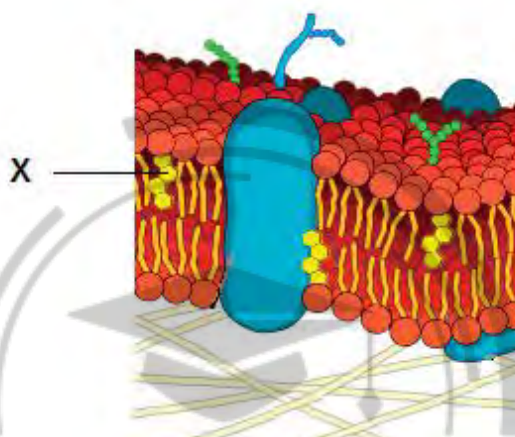
1. Two populations of the same fish species were fed different diets to investigate the effect of differing nutrition on their growth. What is an appropriate method to determine the significance of a resulting difference?
 - A. Calculate the mean for each population
 - B. Calculate the standard deviation for each population
 - C. Graph the results
 - D. Perform a *t*-test

2. Which shows the order of size from smallest to largest?
 - A. Viruses → cell membrane thickness → eukaryotic cells → prokaryotic cells
 - B. Cell membrane thickness → prokaryotic cells → viruses → eukaryotic cells
 - C. Cell membrane thickness → viruses → prokaryotic cells → eukaryotic cells
 - D. Viruses → cell membrane thickness → prokaryotic cells → eukaryotic cells

3. Animal cells often secrete glycoproteins as extracellular components. What is a role of these glycoproteins?
 - A. Adhesion
 - B. Additional energy reserve
 - C. Membrane fluidity
 - D. Water uptake

4. During which stage does the cell surface area to volume ratio decrease?
 - A. Interphase
 - B. Metaphase
 - C. Telophase
 - D. Cytokinesis

5. What describes nuclear division in stem cells?
- A. Clonal selection
 - B. Mitosis
 - C. Cytokinesis
 - D. Meiosis
6. The diagram shows a plasma membrane.



[Source: https://upload.wikimedia.org/wikipedia/commons/d/da/Cell_membrane_detailed_diagram_en.svg]

Which molecule is labelled X?

- A. Cholesterol
- B. Glycoprotein
- C. Phospholipid
- D. Amylase

7. Which always contains carbon, hydrogen and oxygen?

- I. Carbohydrate
- II. Protein
- III. Fat

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

8. What is decreased when lactase is added to milk?

- A. Sweetness
- B. Disaccharides
- C. Calcium
- D. Monosaccharides

9. What is required to replicate DNA?

- A. Temperature of 37°C
- B. Free nucleotides carrying A, C, G and T bases
- C. Plasmids
- D. Endonuclease

10. The image shows a lady picking tea (*Camellia sinensis*) leaves.



[Source: "SriLanka TeaHarvest (pixinn.net)" by Christophe Meneboeuf - Own work. More photos related to Sri Lanka on my photoblog: <http://www.pixinn.net>. Licensed under CC BY-SA 3.0 via Commons - [https://commons.wikimedia.org/wiki/File:SriLanka_TeaHarvest_\(pixinn.net\).jpg#/media/File:SriLanka_TeaHarvest_\(pixinn.net\).jpg](https://commons.wikimedia.org/wiki/File:SriLanka_TeaHarvest_(pixinn.net).jpg#/media/File:SriLanka_TeaHarvest_(pixinn.net).jpg) (cropped)]

Once the leaves have been picked, all further metabolism must be stopped. By what means could this be accomplished?

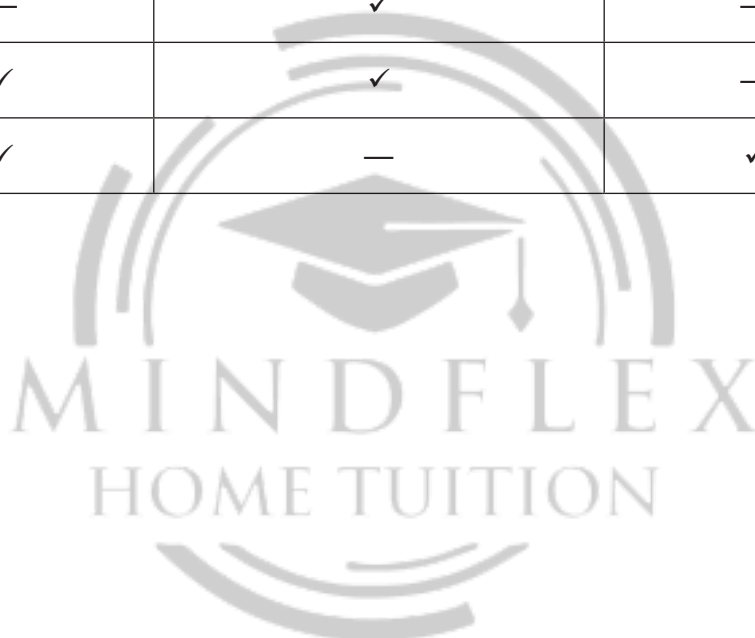
- A. Heating
 - B. Adding water
 - C. Mechanical cutting
 - D. Spraying with anti-fungal agent
11. In a person who is heterozygous for sickle-cell anemia, where is the mutation found?
- A. In every gamete produced
 - B. Only in gametes carrying an X chromosome
 - C. In all brain cells
 - D. In blood plasma
12. What is the chromosome number in a human gamete with non-disjunction?
- A. 46
 - B. 45
 - C. 24
 - D. 23

13. In a human with type A blood, what determines the blood group?

- A. Sex chromosomes
- B. One or two alleles
- C. Multiple alleles
- D. Codominant alleles

14. How are enzymes used during gene transfer involving plasmids and chromosomal DNA?

| | To cut plasmids | To extract gene from DNA | To rejoin DNA |
|----|-----------------|--------------------------|---------------|
| A. | ✓ | ✓ | ✓ |
| B. | — | ✓ | — |
| C. | ✓ | ✓ | — |
| D. | ✓ | — | ✓ |



15. The image shows a female Golden Orb-weaving spider (*Nephila plumipes*). They can grow as large as 4 cm and build webs strong enough to trap small birds for food.



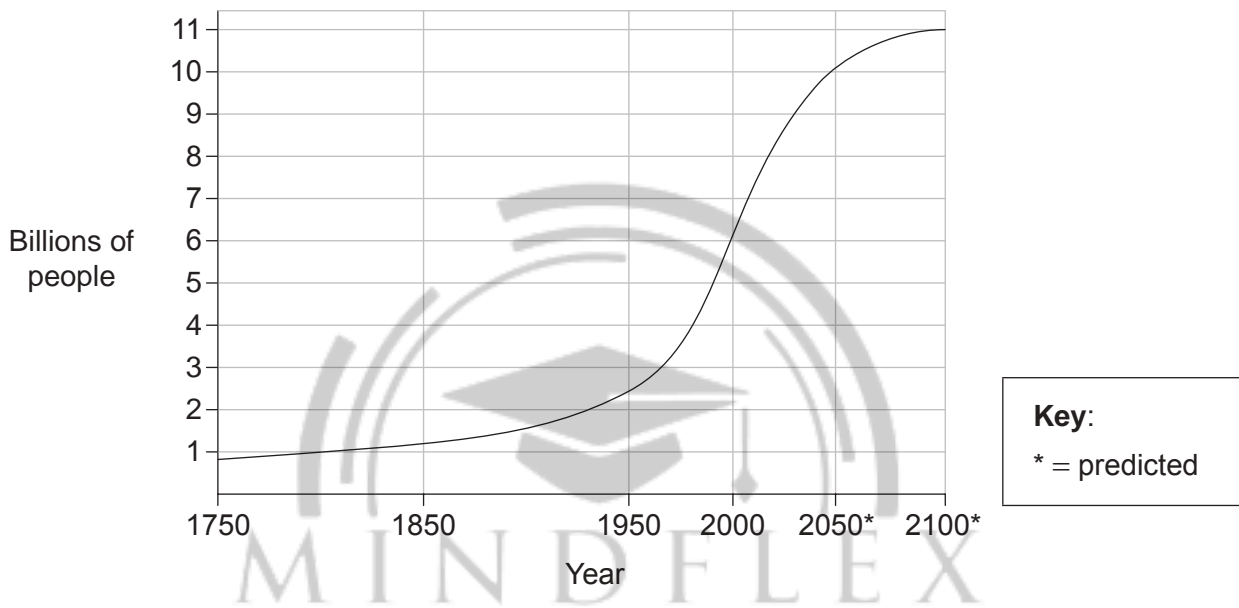
[Source: © Mark Crocker. Used with permission.]

Which of the following describe(s) this spider?

- I. Primary consumer
 - II. Heterotroph
 - III. Arthropod
- A. I only
 - B. I and II only
 - C. II and III only
 - D. I, II and III
16. Which hypothesis is supported by evidence from ecological research?
- A. Decomposers are the final stage in the food chain.
 - B. Producers depend upon consumers more than on decomposers.
 - C. Decomposers help to recycle energy from food chains.
 - D. Producers use nutrients that decomposers help to recycle.

17. What contributes to the enhanced greenhouse effect?
- A. Ozone from violent thunderstorms
 - B. Carbon particles in diesel engine exhaust
 - C. Methane from agricultural sources
 - D. Carbon dioxide from active volcanoes around the world

18. The graph shows the world's population growth from 1750 to 2100*.



[Source: Data source: United Nations]

What would explain the difference between the predicted world population curve compared with the curve up to the present day?

- A. Enhanced food production
- B. Improved health care
- C. Decreasing natality
- D. Increasing emigration

19. The image shows an *Acacia tortilis* tree which is one of 13 species of *Acacia*. All such flowering trees are examples of Fabaceae.



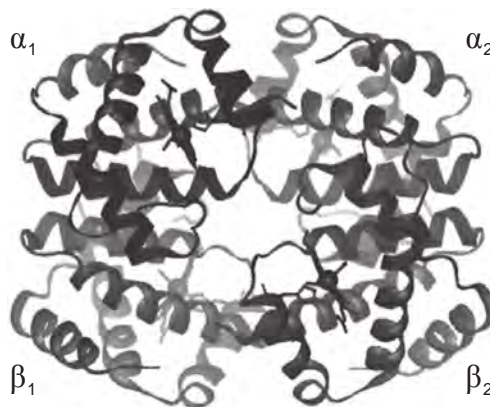
[Source: "Eat267". Licensed under CC BY-SA 3.0 via Commons - <https://commons.wikimedia.org/wiki/File:Eat267.jpg#/media/File:Eat267.jpg>]

What is the highest level of taxa for *Acacia tortilis*?

- A. *Acacia*
 - B. *Tortilis*
 - C. Fabaceae
 - D. Angiospermophyta
20. What structures in the small intestine transport most fats?
- A. Collecting ducts
 - B. Capillaries
 - C. Veins
 - D. Lacteals
21. What causes heart ventricles to fill with blood?
- I. Atrial contraction
 - II. Closing of atrio-ventricular valves
 - III. Opening of semilunar valves
- A. I only
 - B. I and II only
 - C. II and III only
 - D. III only

22. Which is the correct statement concerning HIV and AIDS?
- A. All HIV patients have AIDS.
 - B. HIV and AIDS are transmitted on the sex chromosomes.
 - C. All AIDS patients have HIV.
 - D. HIV and AIDS neutralize antibodies.
23. What happens first when a neurotransmitter binds to a postsynaptic neuron?
- A. Ions diffuse
 - B. Electrophoresis begins
 - C. Ca^{2+} channels open
 - D. Repolarization
24. How does the hypothalamus respond to a very high body temperature?
- A. Increases muscle contraction
 - B. Stops receiving sensory input
 - C. Causes dilation of skin arterioles
 - D. Slows the heart rate
25. What happens during transcription in eukaryotes?
- A. Polysomes move.
 - B. Nucleosomes are phosphorylated.
 - C. RNA polymerase separates DNA strands.
 - D. Okazaki fragments are produced.

26. The image shows the structure of hemoglobin.

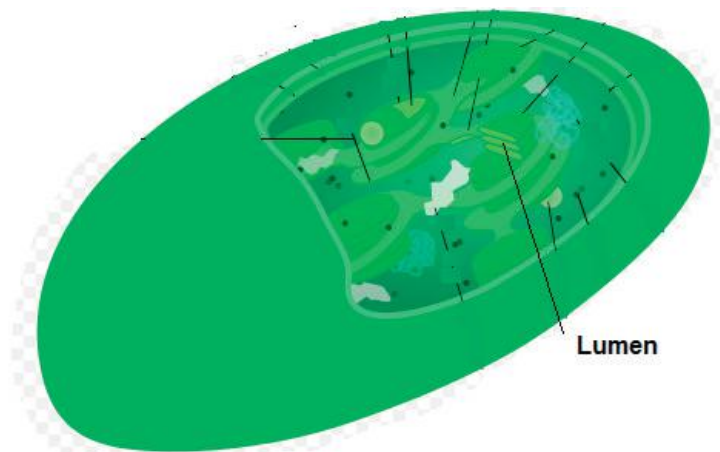


[Source: http://upload.wikimedia.org/wikipedia/commons/b/ba/Hemoglobin_t-r_state_ani.g]

What determines the primary structure of hemoglobin?

- A. Genetic information
 - B. Hydrogen bonding
 - C. Four polypeptide chains
 - D. Side chain interactions
27. What kind of binding changes the shape of an allosteric enzyme so it can slow down a metabolic pathway?
- A. Substrate to active site
 - B. Substrate to allosteric site
 - C. End-product to active site
 - D. End-product to allosteric site
28. From which substrate is the first carbon dioxide molecule released during cellular respiration?
- A. Glucose
 - B. Pyruvate
 - C. Acetyl CoA
 - D. Citrate (a C₆ intermediate compound in the Krebs cycle)

29. The image shows a chloroplast.



[Source: "Chloroplast mini" by Kelvinsong - Own work. Licensed under CC BY 3.0 via Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Chloroplast_mini.svg#/media/File:Chloroplast_mini.svg]

During photosynthesis, what happens in the chloroplast at the location labelled lumen?

- A. Protons accumulate.
 - B. Pyruvate undergoes decarboxylation.
 - C. NADH is oxidized.
 - D. Oxygen is produced.
30. What products of the light-dependent reactions are used in the light-independent reactions?
- A. ATP and NADPH
 - B. NADPH and ribulose biphosphate (RuBP)
 - C. CO₂ and ATP
 - D. ATP and O₂
31. When a plant stem bends towards sunlight, what change does auxin promote in the cells on the side of the stem away from the light?
- A. Translocation
 - B. Cell differentiation
 - C. Cell elongation
 - D. Transcription

32. What could be an adaptation of xerophytes?
- A. Stomata only in the lower epidermis
 - B. Extensive root system
 - C. Large surface area of leaves
 - D. Photosynthesis without light-dependent metabolism
33. Which set of conditions stimulates flowering in long-day plants?

| | Dark period | Phytochrome |
|----|--|--------------------------------|
| A. | continuous and more than critical night length | high concentration of P_{fr} |
| B. | continuous and more than critical night length | high concentration of P_r |
| C. | less than critical night length | high concentration of P_{fr} |
| D. | less than critical night length | high concentration of P_r |

34. At which stage of meiosis does a pair of sister chromatids separate?
- A. Metaphase I
 - B. Anaphase I
 - C. Metaphase II
 - D. Anaphase II
35. In a fruit fly experiment, grey body, normal winged (homozygous dominant) fruit flies were mated with black body, short winged (homozygous recessive) fruit flies. The F_1 dihybrid females were then used in a test cross. If the genes are always linked and no crossing over occurs, what would be the predicted ratio in the F_2 generation?
- A. 9:3:3:1
 - B. 1:1:1:1
 - C. 3:1
 - D. 1:1

36. In the production of monoclonal antibodies, B-cells are fused to tumour cells to make hybridoma cells. What can hybridoma cells do?
- A. Divide endlessly
 - B. Ingest antigens
 - C. Become memory cells
 - D. Bind to antibodies
37. A skeletal muscle contains bundles of elongated muscle fibre cells. What is the longest structure within each fibre?
- A. A myosin filament
 - B. The sarcomere
 - C. A myofibril
 - D. The Z line
38. What is a function of synovial fluid in the elbow joint?
- A. Joins the humerus to the radius and ulna
 - B. Grows red blood cells
 - C. Protects the biceps
 - D. Allows easy movement
39. Where are microvilli located in the nephron?
- A. Glomerulus
 - B. Proximal convoluted tubule
 - C. Loop of Henle
 - D. Collecting duct

40. Through what process does a spermatid become a functioning spermatozoan?
- A. Mitosis
 - B. Differentiation
 - C. Fertilization
 - D. Meiosis
-



Markscheme

November 2015

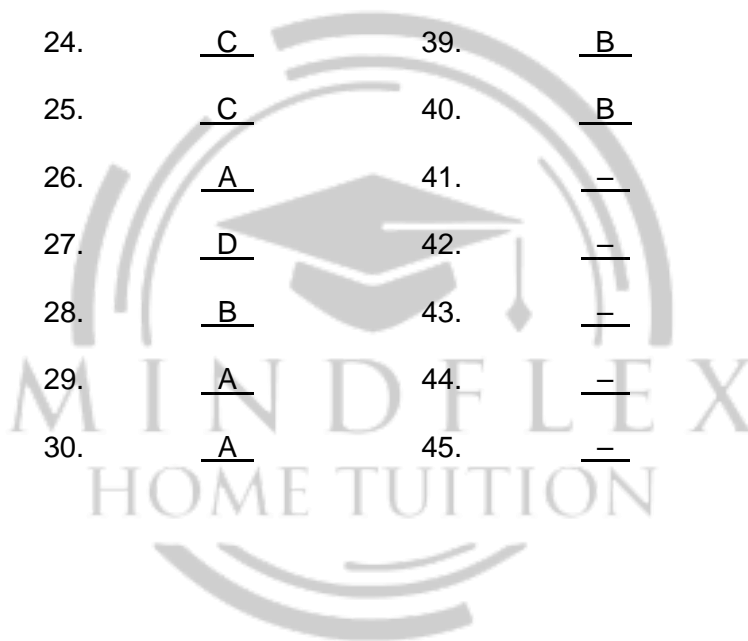

Biology

Higher level

Paper 1

2 pages

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| 1. | <u>D</u> | 16. | <u>D</u> | 31. | <u>C</u> | 46. | <u>-</u> |
| 2. | <u>C</u> | 17. | <u>C</u> | 32. | <u>B</u> | 47. | <u>-</u> |
| 3. | <u>A</u> | 18. | <u>C</u> | 33. | <u>C</u> | 48. | <u>-</u> |
| 4. | <u>A</u> | 19. | <u>D</u> | 34. | <u>D</u> | 49. | <u>-</u> |
| 5. | <u>B</u> | 20. | <u>D</u> | 35. | <u>D</u> | 50. | <u>-</u> |
| 6. | <u>A</u> | 21. | <u>A</u> | 36. | <u>A</u> | 51. | <u>-</u> |
| 7. | <u>D</u> | 22. | <u>C</u> | 37. | <u>C</u> | 52. | <u>-</u> |
| 8. | <u>B</u> | 23. | <u>A</u> | 38. | <u>D</u> | 53. | <u>-</u> |
| 9. | <u>B</u> | 24. | <u>C</u> | 39. | <u>B</u> | 54. | <u>-</u> |
| 10. | <u>A</u> | 25. | <u>C</u> | 40. | <u>B</u> | 55. | <u>-</u> |
| 11. | <u>C</u> | 26. | <u>A</u> | 41. | <u>-</u> | 56. | <u>-</u> |
| 12. | <u>C</u> | 27. | <u>D</u> | 42. | <u>-</u> | 57. | <u>-</u> |
| 13. | <u>B</u> | 28. | <u>B</u> | 43. | <u>-</u> | 58. | <u>-</u> |
| 14. | <u>A</u> | 29. | <u>A</u> | 44. | <u>-</u> | 59. | <u>-</u> |
| 15. | <u>C</u> | 30. | <u>A</u> | 45. | <u>-</u> | 60. | <u>-</u> |



Biology
Higher level
Paper 2

Thursday 5 November 2015 (morning)

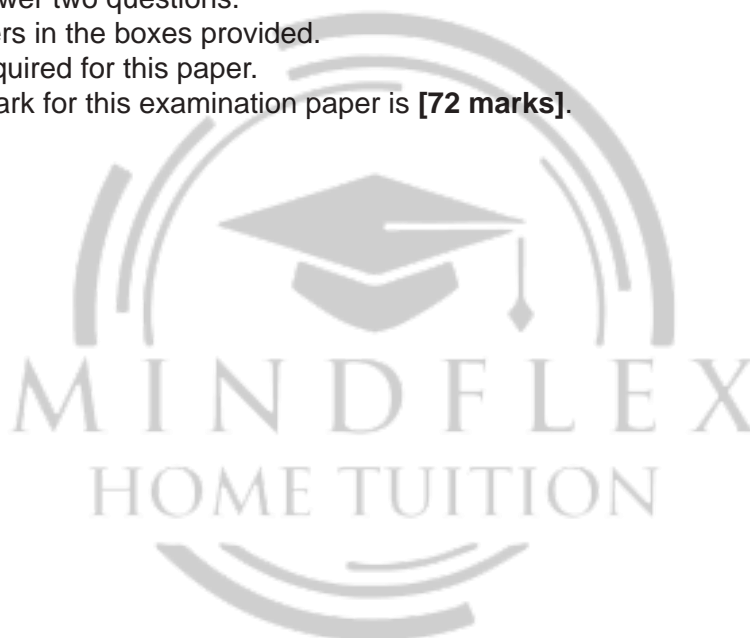
Candidate session number

2 hours 15 minutes

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Instructions to candidates

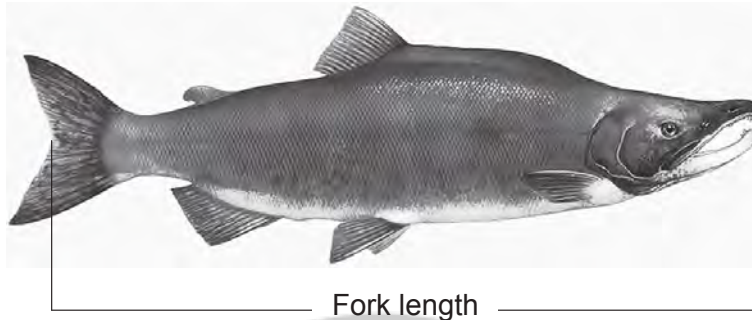
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer two questions.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[72 marks]**.



Section A

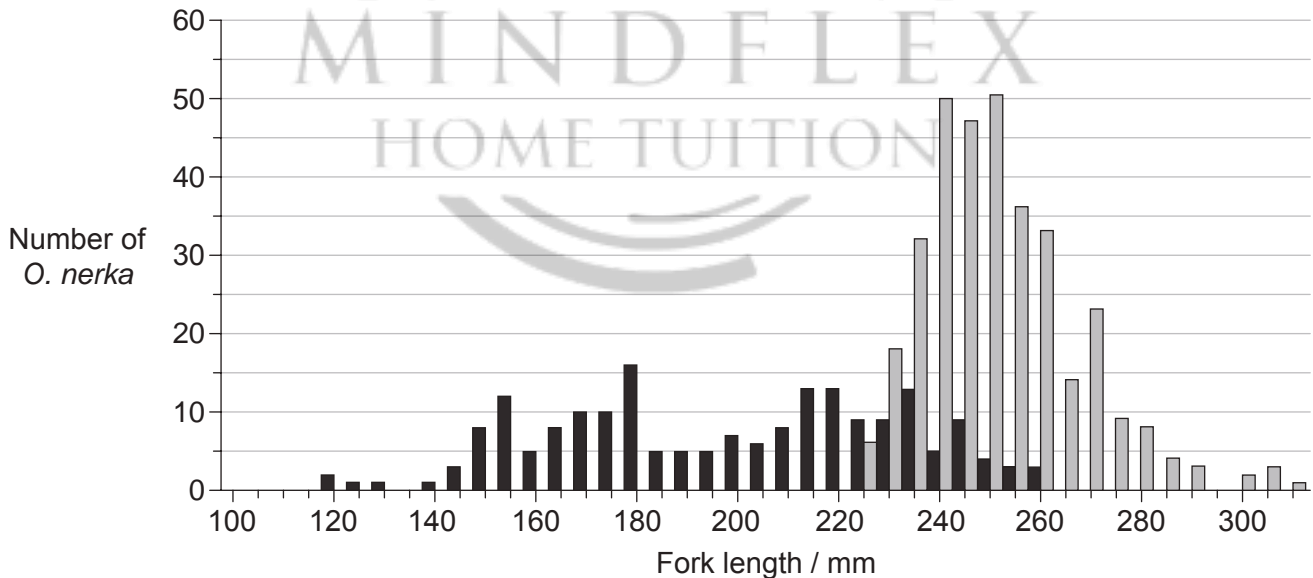
Answer **all** questions. Write your answers in the boxes provided.

1. Sockeye salmon (*Oncorhynchus nerka*) spend the first years of their lives in the freshwater lakes of Alaska before migrating to marine waters. Their first months in marine waters are spent foraging and growing near the shore line. They then move to offshore regions of the North Pacific Ocean for 2 to 3 years.



[Source: "Oncorhynchus nerka" by Timothy Knepp of the Fish and Wildlife Service. - US Fish and Wildlife Service. Licensed under Public Domain via Commons - https://commons.wikimedia.org/wiki/File:Oncorhynchus_nerka.jpg#/media/File:Oncorhynchus_nerka.jpg]

The graph shows fork length frequency of juvenile *O. nerka* caught during their first months in marine waters in autumn 2008 and ocean age one *O. nerka* caught 15 months later during winter 2009 in the North Pacific Ocean.



Key: ■ autumn 2008 (juvenile *O. nerka*) □ winter 2009 (ocean age one *O. nerka*)

[Source: Adapted from Edward V. Farley, Alexander Starovoytov, Svetlana Naydenko, Ron Heintz, Marc Trudel, Charles Guthrie, Lisa Eisner and Jeffrey R. Guyon (2011) 'Implications of a warming eastern Bering Sea for Bristol Bay sockeye salmon'. *ICES Journal of Marine Science*, 68 (6), pages 1138–1146, by permission of Oxford University Press.]

(This question continues on the following page)



(Question 1 continued)

- (a) Identify the **total** number of *O. nerka* with fork length from 240 to 245 mm caught in autumn 2008 and winter 2009. [1]

.....

- (b) Compare the data in the graph for autumn 2008 and winter 2009. [3]

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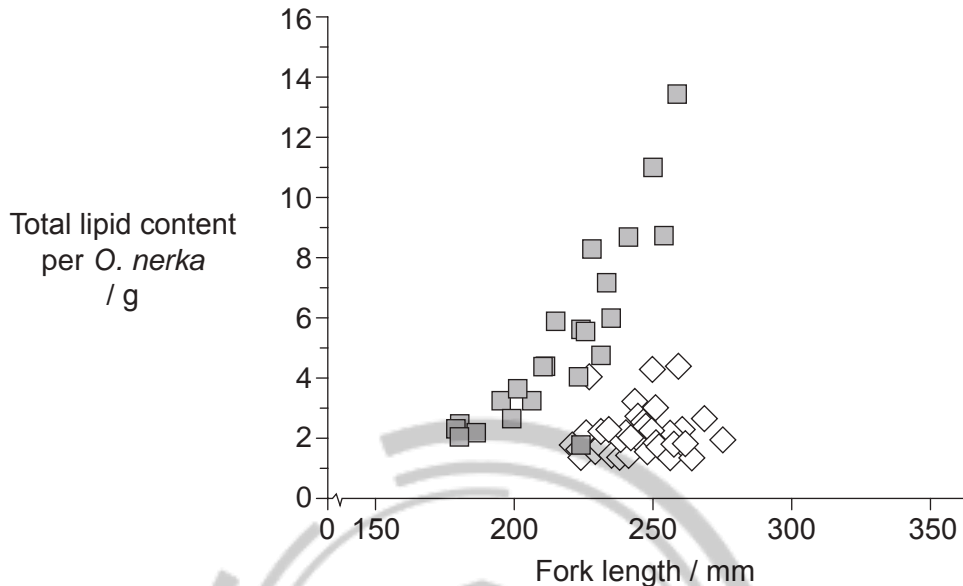
- (c) Suggest **two** factors that could affect the distribution of *O. nerka* in the North Pacific Ocean. [2]

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(This question continues on the following page)

(Question 1 continued)

Lipid in *O. nerka* was measured to evaluate possible differences in energy status during their first 15 months at sea. The graph shows the relationship between fork length and lipid content for *O. nerka* caught during autumn 2008 and winter 2009.



Key: ■ autumn 2008 (juvenile *O. nerka*) ◇ winter 2009 (ocean age one *O. nerka*)

[Source: Adapted from Edward V. Farley, Alexander Starovoytov, Svetlana Naydenko, Ron Heintz, Marc Trudel, Charles Guthrie, Lisa Eisner and Jeffrey R. Guyon (2011) 'Implications of a warming eastern Bering Sea for Bristol Bay sockeye salmon'. *ICES Journal of Marine Science*, **68** (6), pages 1138–1146, by permission of Oxford University Press.]

(d) State the range of lipid content measured in *O. nerka* caught during autumn 2008. [1]

..... g

(e) Outline any correlation between total lipid content and fork length in autumn 2008 and in winter 2009. [2]

Autumn 2008:

Winter 2009:

(This question continues on the following page)



(Question 1 continued)

(f) Suggest reasons for the differences in lipid content.

[2]

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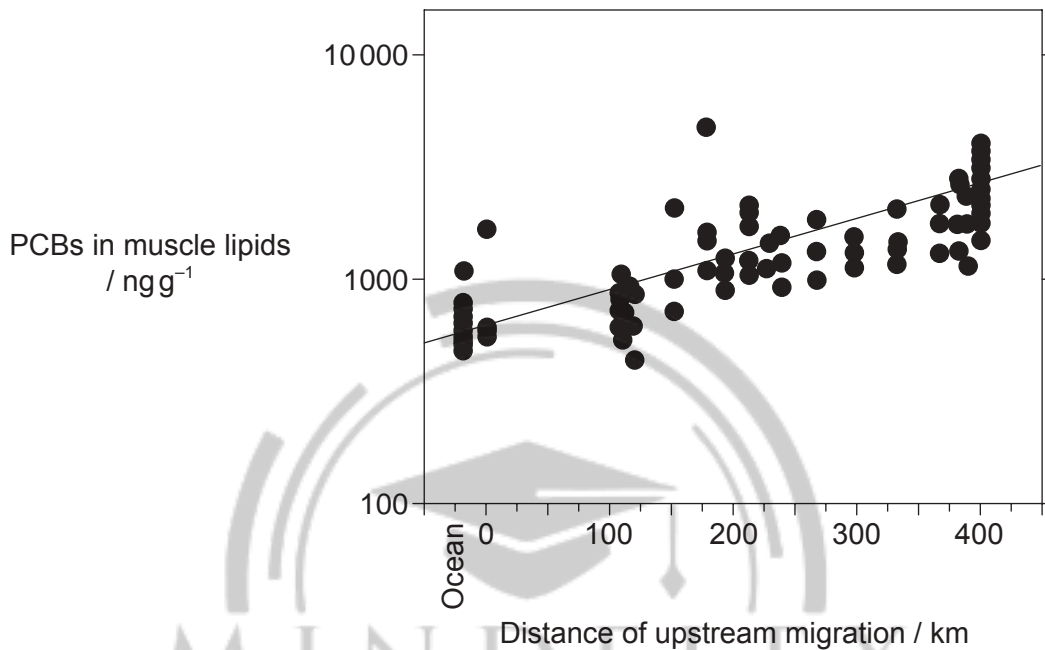
(This question continues on the following page)



(Question 1 continued)

Persistent organic pollutants, such as polychlorinated biphenyls (PCBs), have been shown to reach unpolluted arctic areas by air currents. Another method of transport of these pollutants into these ecosystems is provided by migrating *O. nerka*.

Pollutant transport was studied in a population of *O. nerka* in the Copper River (Alaska). The graph shows concentration of PCBs in muscle lipids of *O. nerka* in relation to the distance of upstream migration.



[Source: Ewald, Göran, Per Larsson, Henric Linge, Lennart Okla, & Nicole Szarzi. "Biotransport of Organic Pollutants to an Inland Alaska Lake by Migrating Sockeye Salmon (*Oncorhynchus nerka*)." *ARCTIC*, 51.1 (1998): 40–47. Used with permission from the Arctic Institute of North America.]

- (g) Describe the relationship between the distance of upstream migration and the concentration of PCBs in *O. nerka*. [1]

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- (h) State the concentration of PCBs in muscle lipids at 125 km from the ocean estimated by the correlation line. [1]

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(This question continues on the following page)



(Question 1 continued)

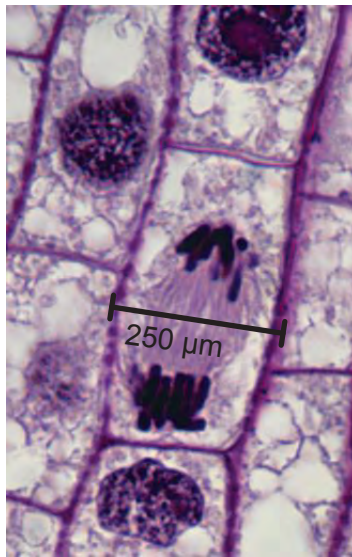
- (i) As the *O. nerka* migrate upstream they no longer feed. Suggest a reason for the relationship of distance of upstream migration and concentration of PCBs in muscle lipids.

[1]

.....
.....



2. (a) The micrograph shows a cell from the root of an onion (*Allium cepa*) during mitosis.



[Source: © Ed Reschke used with permission by Getty Images]

- (i) Calculate the magnification of the image. [1]

.....

MIND FLEX
HOME TUITION

- (ii) Deduce the stage of mitosis shown in the micrograph. [1]

.....

- (iii) The onion (*Allium cepa*) is an angiospermophyte. The honey bee (*Apis mellifera*) is an arthropod. State **three** structural differences between the cells of an onion and a honey bee. [2]

1.

2.

3.

(This question continues on the following page)



(Question 2 continued)

(b) State what is indicated by the presence of polysomes in a cell.

[1]

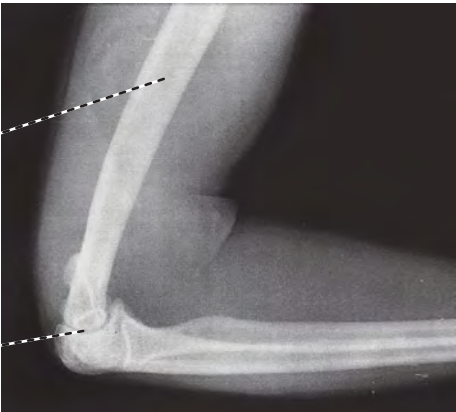
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3. (a) (i) Label the structures indicated on the X-ray of a human elbow. [2]

X:

Y:



[Source: © International Baccalaureate Organization 2016]

- (ii) State the role of tendons. [1]

.....

- (b) Explain the role of calcium in muscle contraction. [3]

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(This question continues on the following page)



(Question 3 continued)

(c) One of the stages of aerobic respiration is called the link reaction.

(i) Label the diagram to indicate where the link reaction occurs.

[1]



(ii) Outline the role of coenzyme A in aerobic respiration.

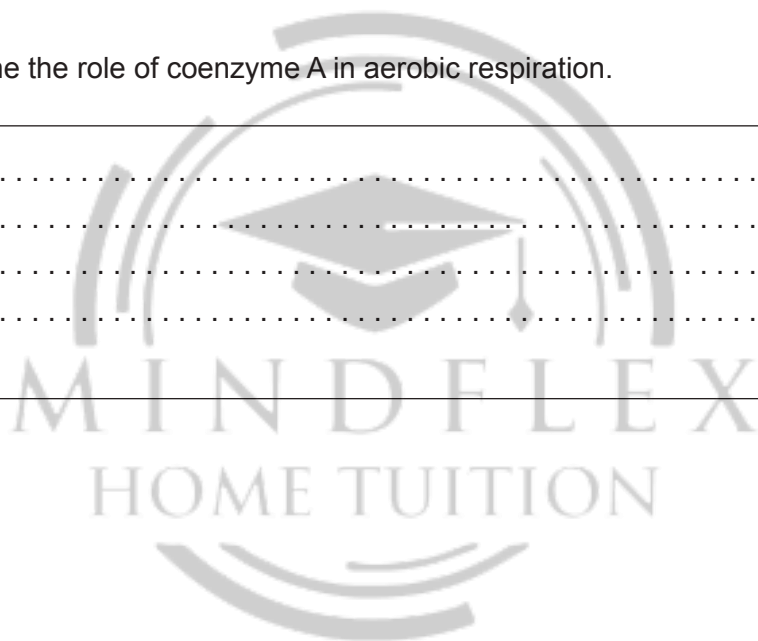
[2]

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4. In the pea plant (*Pisum sativum*), the allele for tall plants is A and the allele for short plants is a. The allele for green plants is B and the allele for yellow plants is b.

(a) Determine the phenotype of Aabb.

[1]

.....

(b) Compare the information that could be deduced when the genotypes are presented as

AaBb or $\frac{A B}{a b}$.

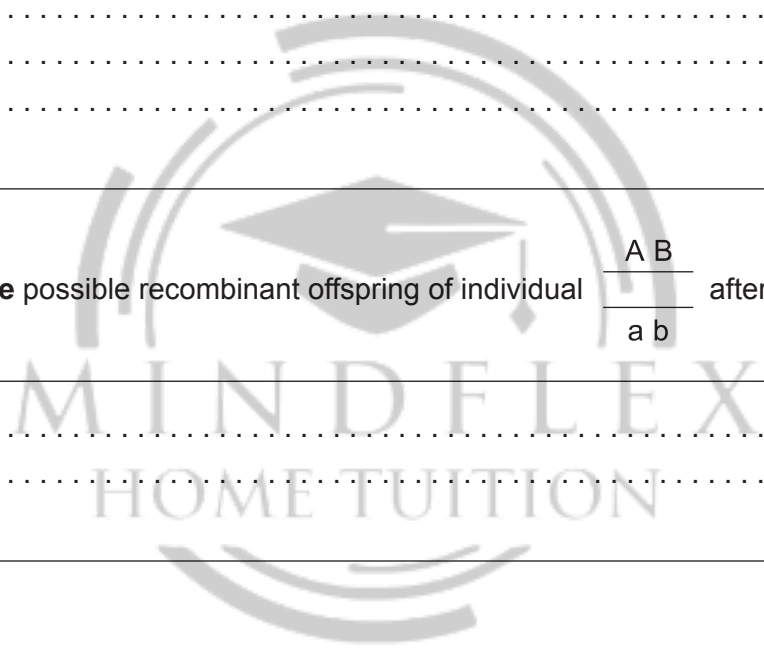
[2]

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(c) Deduce **one** possible recombinant offspring of individual $\frac{A B}{a b}$ after a test cross.

[1]

.....
.....



Section B

Answer **two** questions. Up to two additional marks are available for the construction of your answers. Write your answers in the boxes provided.

5. (a) Draw a labelled diagram of a mature human egg. [5]
- (b) Outline a technique used for gene transfer. [5]
- (c) Explain how evolution may happen in response to environmental change with evidence from examples. [8]
6. (a) Draw a labelled diagram to show the structure of a sarcomere. [5]
- (b) Explain how an impulse passes along the axon of a neuron. [8]
- (c) Describe the process of endocytosis. [5]
7. (a) The leaves of plants are adapted for photosynthesis. Draw a labelled plan diagram of a leaf to show the distribution of tissues in a leaf. [5]
- (b) Explain how abiotic factors affect the rate of transpiration in terrestrial plants. [8]
- (c) Describe the importance of water to living organisms. [5]
8. (a) Draw a labelled diagram to show the structure of the heart. [5]
- (b) Outline how the human body responds to high blood glucose levels. [5]
- (c) Explain the role of the nephron in maintaining the water balance of the blood in the human body. [8]

A large rectangular area containing horizontal dotted lines for writing. In the center of this area is a faint watermark logo for MindFlex Home Tuition, featuring a graduation cap inside a circular emblem with the text "MINDFLEX HOME TUITION" below it.



A large rectangular area containing horizontal dotted lines for writing. A faint watermark logo is centered on the page, featuring a graduation cap and the text "MIND FLEX HOME TUITION".



Biology
Higher level
Paper 3

Friday 6 November 2015 (afternoon)

Candidate session number

1 hour 15 minutes

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Instructions to candidates

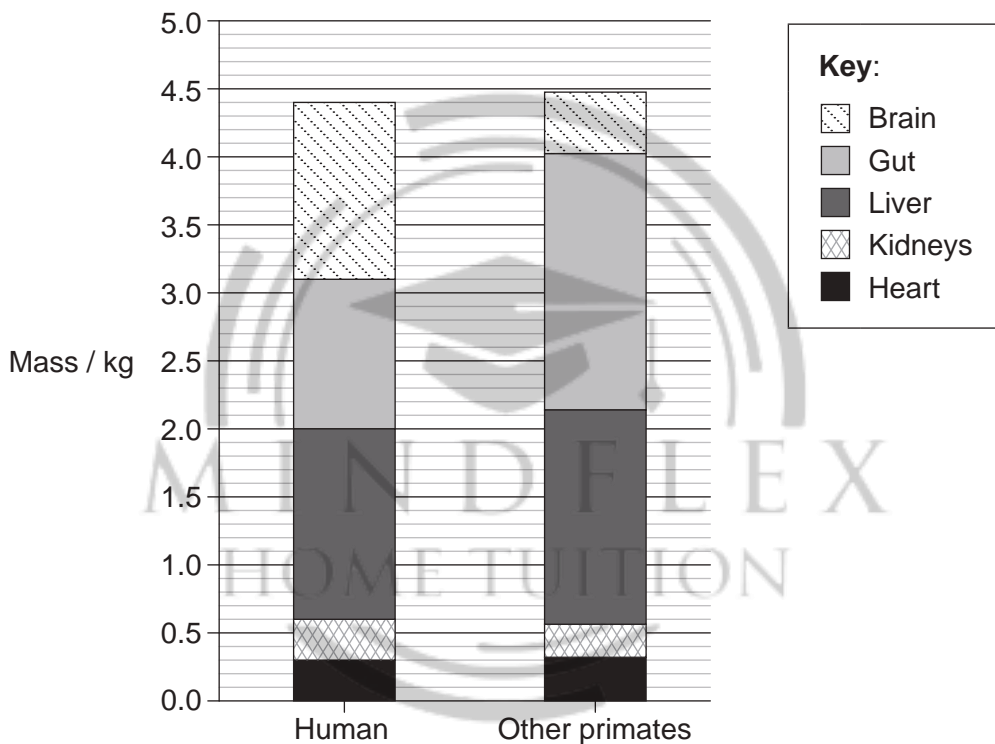
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from two of the options.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[40 marks]**.

| Option | Questions |
|---------------------------------------|-----------|
| Option D — Evolution | 1 – 3 |
| Option E — Neurobiology and behaviour | 4 – 6 |
| Option F — Microbes and biotechnology | 7 – 9 |
| Option G — Ecology and conservation | 10 – 12 |
| Option H — Further human physiology | 13 – 15 |

Option D — Evolution

1. Researchers investigating human evolution recorded energy use for the brain, gastrointestinal tract (gut), liver, kidneys and heart as a percentage of total energy used in the human body. They found that these organs use around 70% of the body's energy although they account for only about 7% of body mass. They also compared the mass of each of these organs in humans with other modern primates, each with a body mass of 65 kg as shown in the bar chart.

| Human organs | Brain | Gut | Liver | Kidneys | Heart |
|--|-------|-----|-------|---------|-------|
| Energy use as percentage of total for body / % | 16 | 15 | 19 | 8 | 11 |



[Source: Brains and guts in human evolution: The Expensive Tissue Hypothesis. *Braz. J. Genet.* [online]. 1997, vol.20, n.1 [cited 2015-11-17]. Available from: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-84551997000100023&lng=en&nrm=iso>. ISSN 1678-4502. <http://dx.doi.org/10.1590/S0100-84551997000100023>.]

(Option D continues on the following page)



(Option D, question 1 continued)

- (a) Calculate the percentage of the total body mass made up by the human brain. [1]

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- (b) Compare the mass of human organs with the mass of other primate organs. [2]

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- (c) Using information from the table and the graph, identify the human organ which uses the greatest amount of energy per kilogram of body tissue. [1]

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- (d) Explain the differences between the organ size of humans and other primates in terms of trends in human evolution and their causes. [4]

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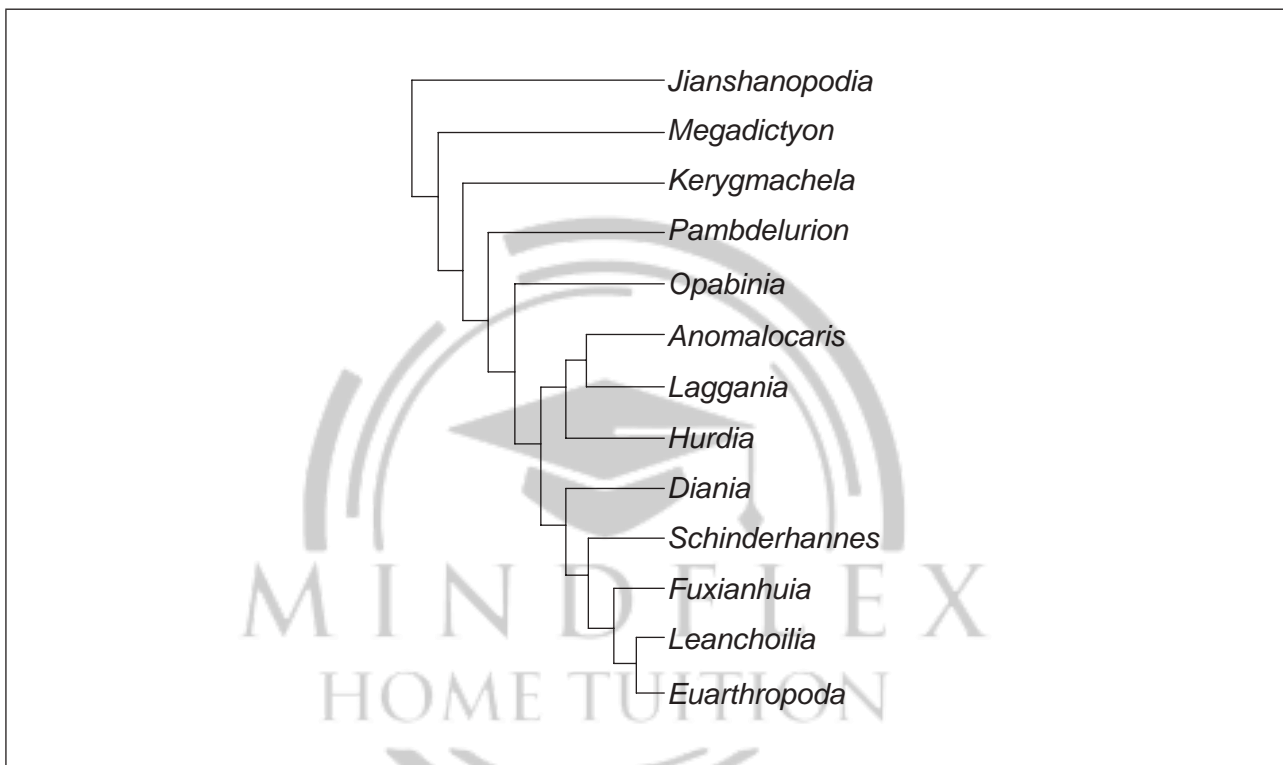


(Option D continued)

2. (a) Distinguish between allopatric speciation and sympatric speciation. [1]

.....

- (b) The diagram shows part of a cladogram for invertebrate species from the Cambrian age.



- (i) On the cladogram, label with the letter C the point that shows the most recent common ancestor of *Pambdelurion* and *Fuxianhuia*. [1]
- (ii) Identify which **two** species evolved most recently. [1]

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(Option D, question 2 continued)

- (c) There is evidence that prokaryotes were responsible for changes in the atmospheric gases 3.5 billion years ago. Outline the role of bacteria in producing an oxygen-rich atmosphere. [3]

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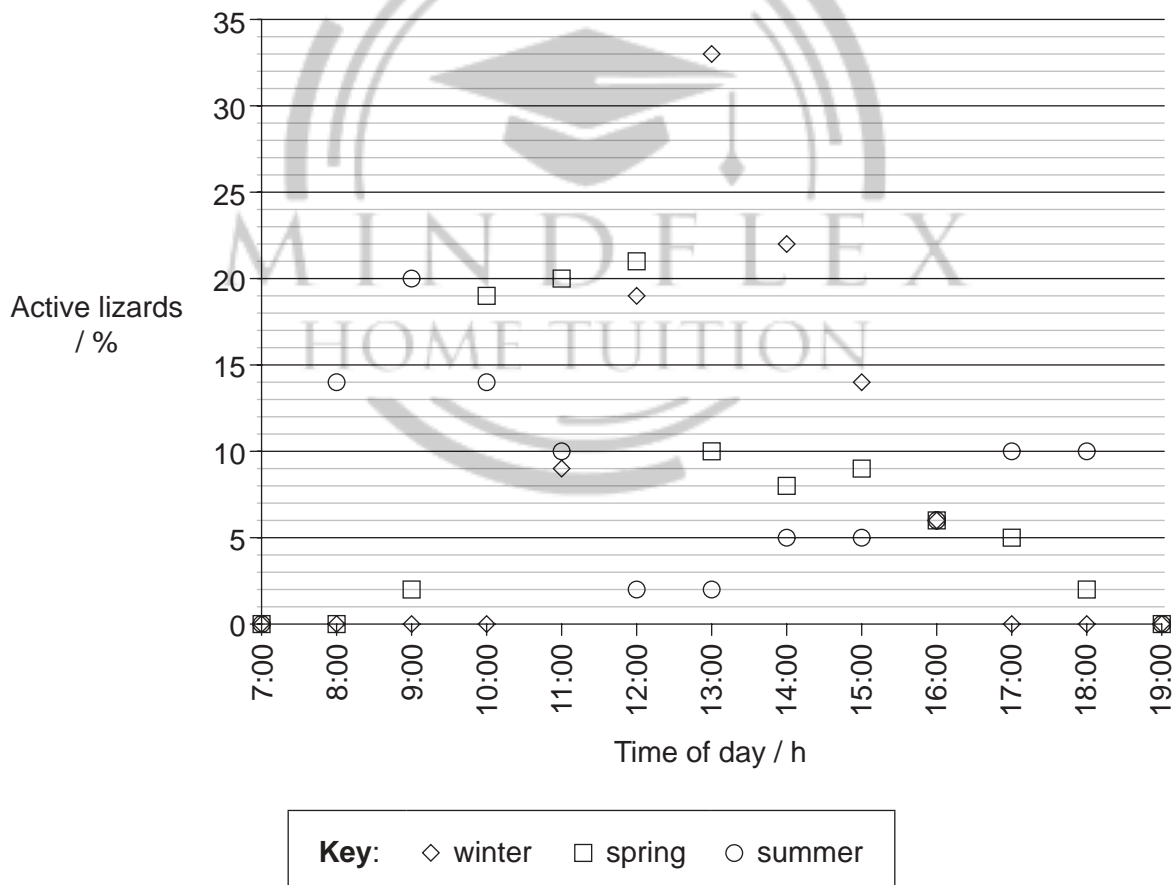
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Option E — Neurobiology and behaviour

4. Lizards living in the Kalahari Desert of southern Africa are diurnal (active in daylight). Scientists studied this rhythmical behaviour during different seasons of the year. Observations were made of the number of lizards active each hour and this was recorded as a percentage of the total number of lizards that were active. The graph shows the results for the Southern Spiny Agama (*Agama hispida*) lizard. Between the hours of 19:00 and 7:00 the lizards were inactive.



[Source: Image courtesy of Trevor Hardaker. www.hardaker.co.za]



[Source: R. B. Huey and E. P. Pianka (1977) *Ecology*, **58**(5): pages 1066–1075.]

(Option E continues on the following page)

(Option E, question 4 continued)

- (a) State **one** time in spring when 5% of the lizards were active. [1]

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- (b) (i) Winter and summer weather conditions differ in the Kalahari Desert. Compare the results for summer and winter. [3]

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- (ii) The temperatures differ in summer and winter. Suggest **one** other possible reason why the lizard activity differs in summer and winter. [1]

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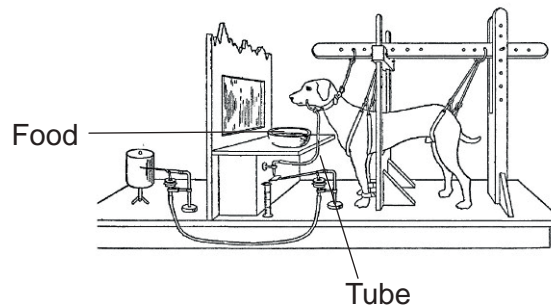
- (c) Outline **one** other example illustrating the adaptive value of a rhythmical behaviour pattern in a **named** animal. [3]

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(Option E continued)

5. (a) The diagram shows the procedure used by Pavlov during his experiment on dogs.



[Source: <http://www.all-about-psychology.com/images/pavlovs-dog.jpg>]

- (i) State the type of stimulus provided by the sight and smell of the food. [1]

.....

- (ii) State the function of the tube. [1]

.....

- (b) State **two** effects presynaptic neurons could have on postsynaptic transmission. [1]

1.
2.

(Option E continues on the following page)



(Option E, question 5 continued)

- (c) Describe **one** experiment that could be used to investigate taxis behaviour in a **named** invertebrate.

[3]

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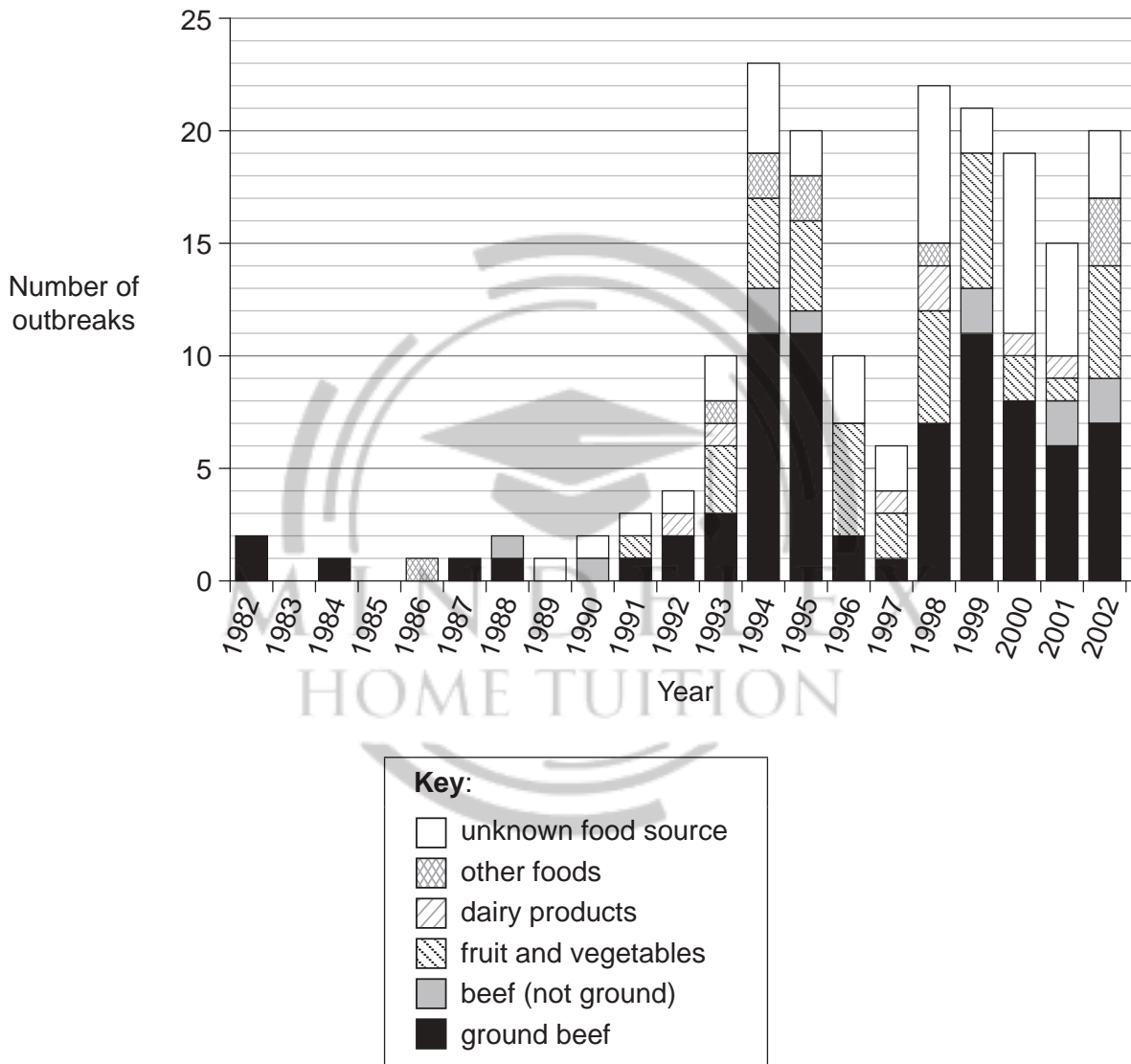
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Option F — Microbes and biotechnology

7. The bacterium *Escherichia coli* is responsible for over 70 000 cases of illness each year in the US. More than half of these cases are due to transmission of the bacteria in food, particularly from ground beef in undercooked burgers. Epidemiologists collected evidence from 183 outbreaks of food poisoning between the years 1982 and 2002 and identified the food responsible for the outbreak. They divided the foods into dairy products, fruit and vegetables, beef, ground beef (beef which has been minced) and other foods. In some cases they were unable to identify the food that had caused the outbreak. The results are displayed in the bar chart.



[Source: Rangel JM, Sparling PH, Crowe C, Griffin PM, Swerdlow DL.

Epidemiology of *Escherichia coli* O157:H7 outbreaks, United States, 1982–2002. Emerg Infect Dis [serial on the Internet]. 2004 Apr. Available from <http://wwwnc.cdc.gov/eid/article/11/4/04-0739> DOI: 10.3201/eid1104.040739]

(Option F continues on the following page)



(Option F, question 7 continued)

- (a) State the number of years during the study when contaminated dairy products caused food poisoning. [1]

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- (b) (i) Compare the outbreaks of food poisoning in 1989 and 1994. [2]

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- (ii) Suggest **two** reasons for these changes. [2]

1.
2.

- (c) Explain how pasteurization may have prevented food poisoning by dairy products. [2]

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(Option F continued)

8. (a) State **one** example of a bacterium that forms aggregates. [1]

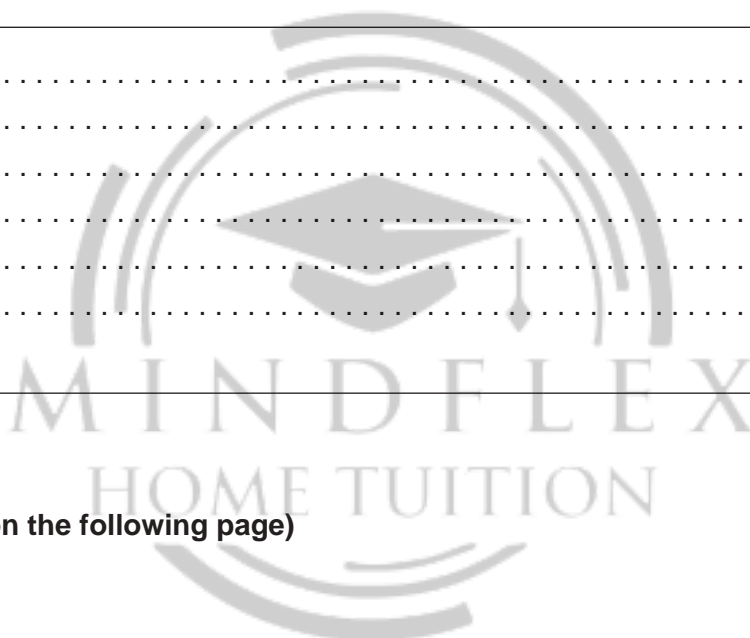
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- (b) State the type of bacteria that are adapted to a habitat with high salt concentrations. [1]

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- (c) Outline the process of nitrogen fixation by a **named** free-living bacterium. [2]

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(Option F continues on the following page)



(Option F, question 8 continued)

(d) The image shows part of a sewage treatment plant.



[Source: "Trickling filter bed 2 w" by Velela - Transferred from en.wikipedia.org [1]: 2005-01-16 21:23 Velela 1296x972 (680941 bytes). Licensed under Public Domain via Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Trickling_filter_bed_2_w.JPG#/media/File:Trickling_filter_bed_2_w.JPG]

Outline the role of bacteria in trickling filter bed treatment of sewage.

[3]

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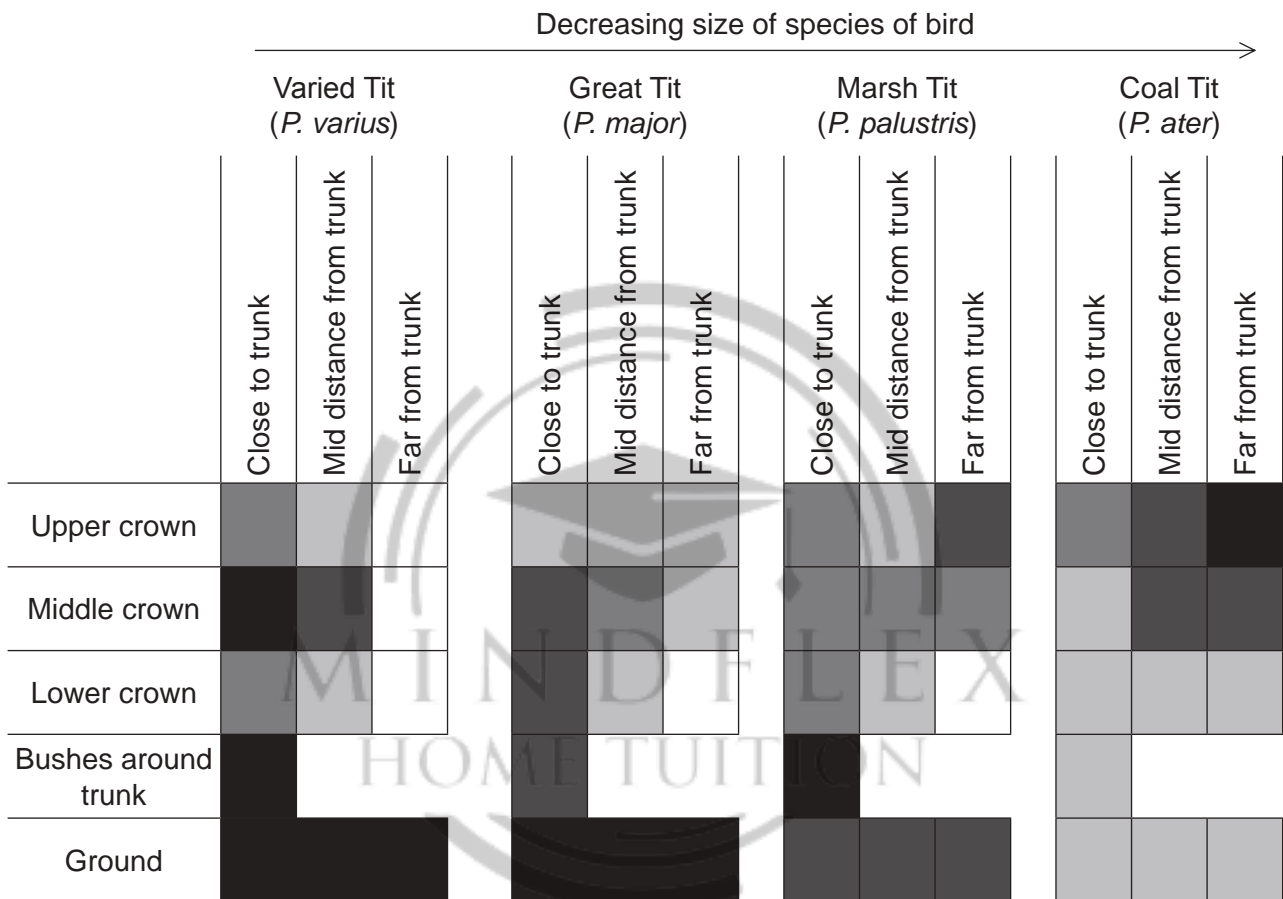
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Option G — Ecology and conservation

10. In South Korea, flocks of birds of the tit family (*Paridae*) forage together on trees for food. Researchers observed four species of *Paridae* to determine whether they shared the same habitat in the trees and whether their position on the tree depended on their size. The leafy part of the tree (crown) was divided into nine sections, three according to height from the ground and three according to the distance from the tree trunk. Observations were also made of birds foraging in the bushes surrounding the trunk and on the ground below the tree. The chart shows the relative use of each section of the habitat by the birds.



[Source: S. Lee and P. G. Jablonski (2006) *Polish Journal of Ecology*, 54 (3), pages 481–490.]

(Option G continues on the following page)



(Option G, question 10 continued)

- (a) State the relative use of the habitat by the Great Tit in the upper crown of the tree close to the trunk. [1]

.....

- (b) Identify the section of habitat used least by the birds. [1]

.....

- (c) Compare how the Varied Tit and the Marsh Tit use the habitat in the upper crown of the tree. [2]

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- (d) State how the distribution of birds changes with their size in the middle crown of the tree. [1]

.....

- (e) Suggest **one** reason why few Varied Tits were found far from trunk. [1]

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(Option G continues on the following page)

(Option G, question 10 continued)

- (f) Discuss whether the results for the Varied Tit and Coal Tit indicate competitive exclusion. [2]

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(Option G continues on the following page)



(Option G continued)

11. (a) (i) State which environmental conditions would favour r-strategies of reproduction over K-strategies. [1]

.....

- (ii) Outline **one** advantage to a species of using r-strategy. [1]

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- (b) Outline how habitat corridors can aid conservation of biodiversity in a nature reserve. [1]

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- (c) Explain how living organisms can change the abiotic environment during primary succession. [3]

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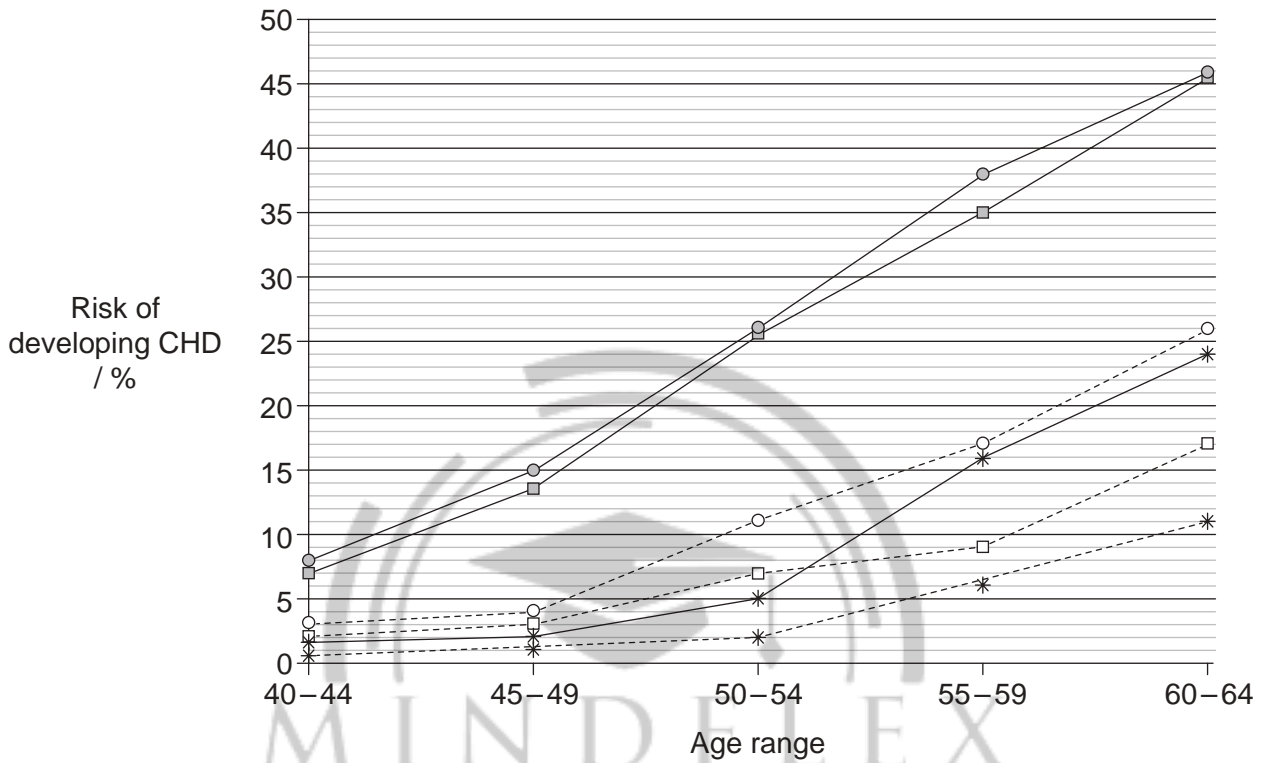
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Option H — Further human physiology

13. Coronary heart disease (CHD) is common in some families, with men being more susceptible to the disease than women. Researchers in Finland carried out an investigation to determine whether the pattern within families was the same for women as for men. The graph shows how the risk of developing CHD in men and women of certain ages depends on whether they had a brother or sister with the disease.



Key:

- men whose brothers had CHD
- men whose sisters had CHD
- *— male control
- women whose brothers had CHD
- women whose sisters had CHD
- *-- female control

[Source: Pohjola-Sintonen S. *et al.* Family history as a risk factor of coronary heart disease in patients under 60 years of age. *European Heart Journal* Feb 1998, **19** (2), 235–239; DOI: 10.1053/euhj.1997.0543, Figs 1 & 2. © 1998, by permission of Oxford University Press.]

- (a) State the risk of a man developing CHD between the ages of 55–59 if his brother had CHD.

[1]

.....

(Option H continues on the following page)



(Option H, question 13 continued)

- (b) Calculate the increase in risk over the control group for a woman of 60–64 of developing CHD if her sister had the disease. [1]

.....%

- (c) Compare the results for the men and the women. [3]

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- (d) Suggest **two** reasons why a man is more likely to develop CHD if his brother had the disease. [2]

1.
2.

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(Option H continued)

14. (a) State the pathway by which hormones travel from the hypothalamus to the anterior pituitary gland. [1]

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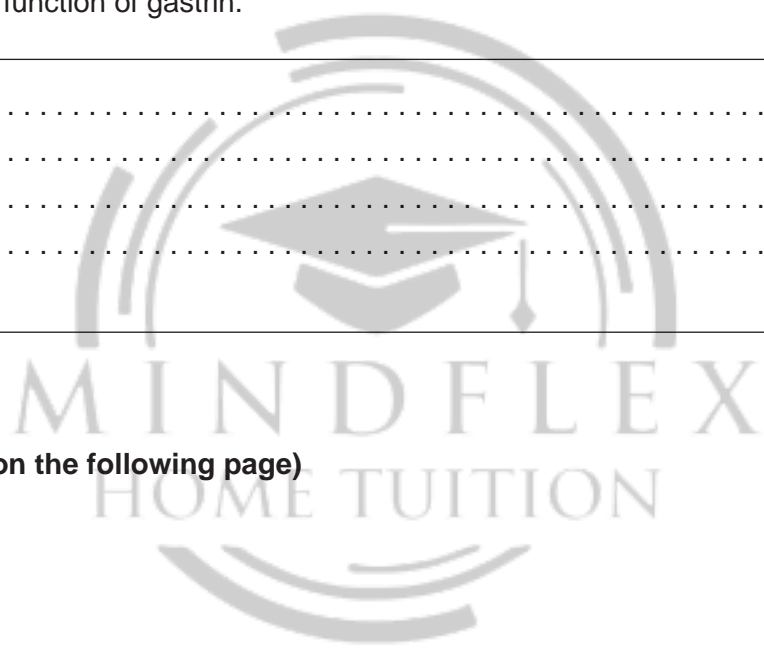
- (b) State the condition of the blood that would stimulate the release of ADH (vasopressin). [1]

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- (c) Outline the function of gastrin. [2]

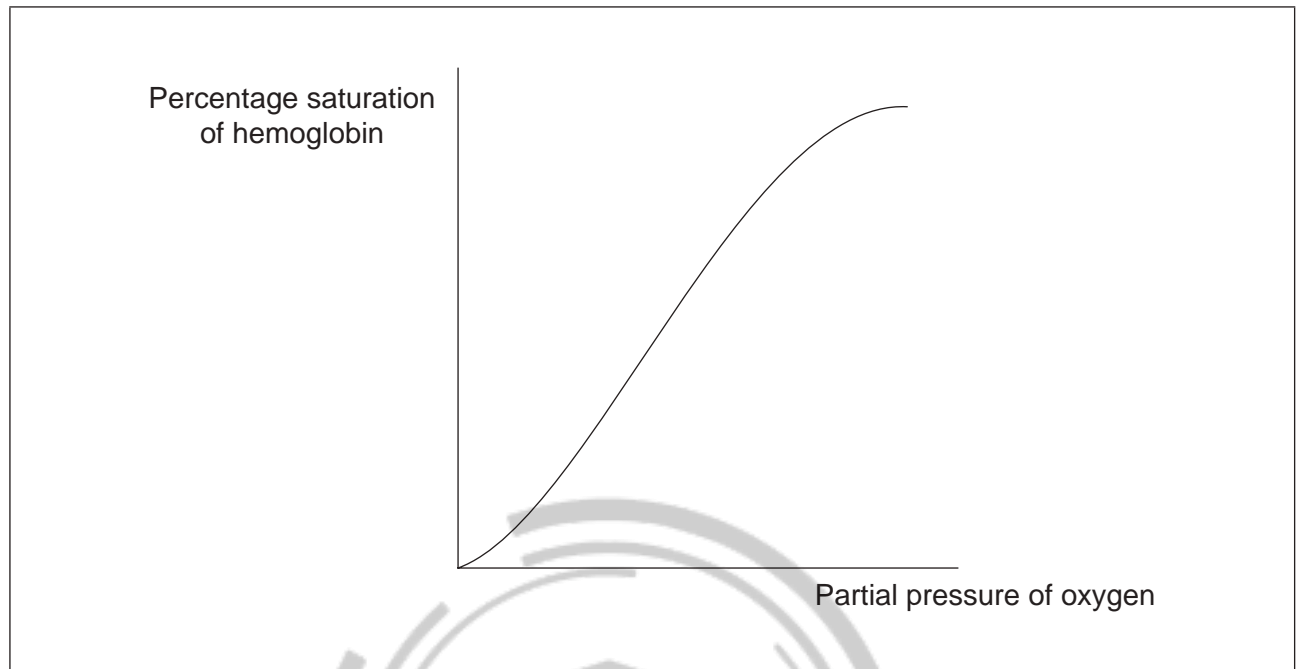
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(Option H, question 14 continued)

(d) The graph shows the oxygen dissociation curve for adult hemoglobin.



- (i) Using the graph, draw a line to show how the oxygen dissociation curve changes with the Bohr shift. [1]
- (ii) Explain the role of the Bohr shift during vigorous exercise. [2]

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